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Cossins

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(54) **METHOD FOR ASSEMBLY OF RECESSED PANEL DOORS**

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B32B 37/10	(2006.01)
B32B 3/12	(2006.01)
B32B 29/00	(2006.01)
E06B 3/82	(2006.01)

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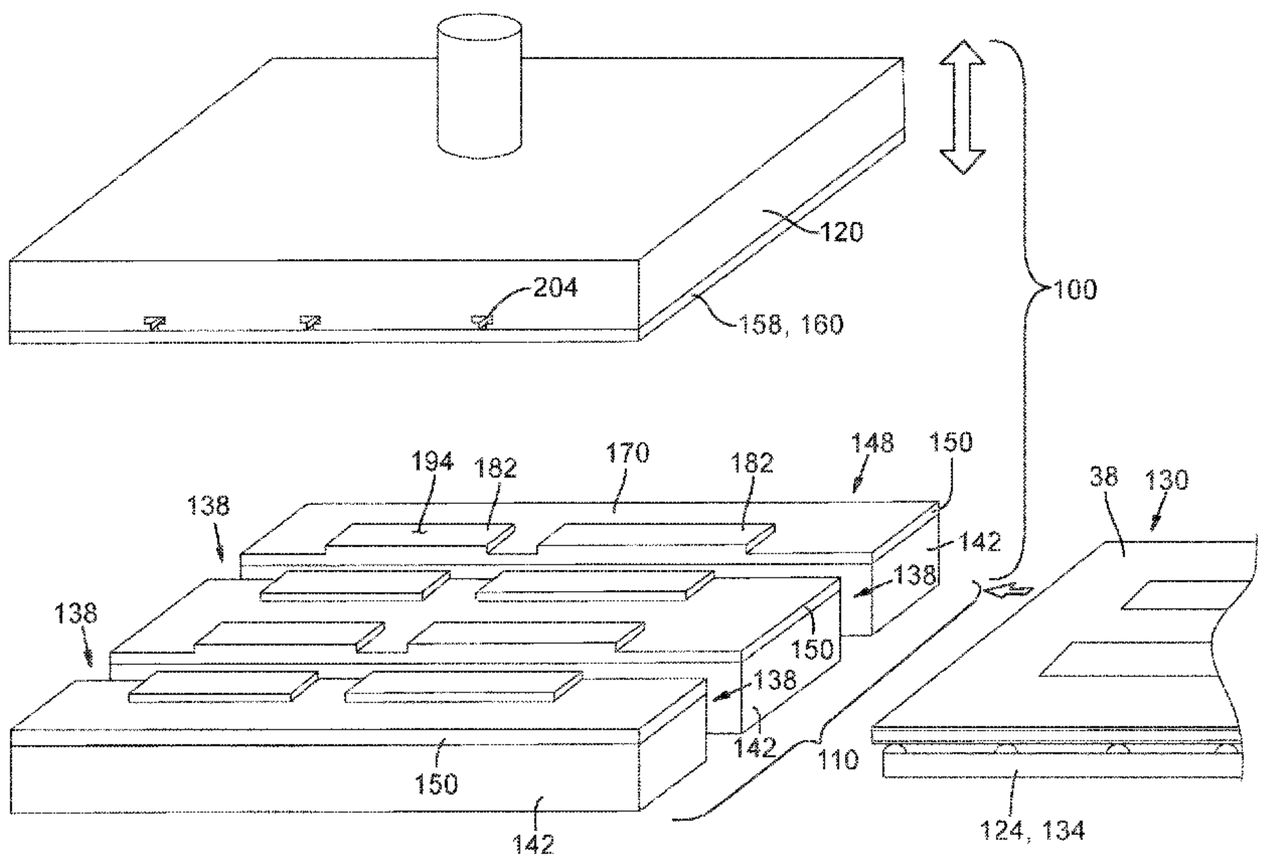
(57) **ABSTRACT**

Systems and methods for pressing a door assembly involve one or more die sections installed in a press, wherein the die sections each have a raised section that contacts and supports a recessed panel portion of a door skin of the assembly during the pressing operation to facilitate crushing of portions of a core of the door assembly that underlie the recessed panel portion of the door skin. The die sections may be made of plastic and readily changed out for different sizes or styles of doors.

15 Claims, 4 Drawing Sheets



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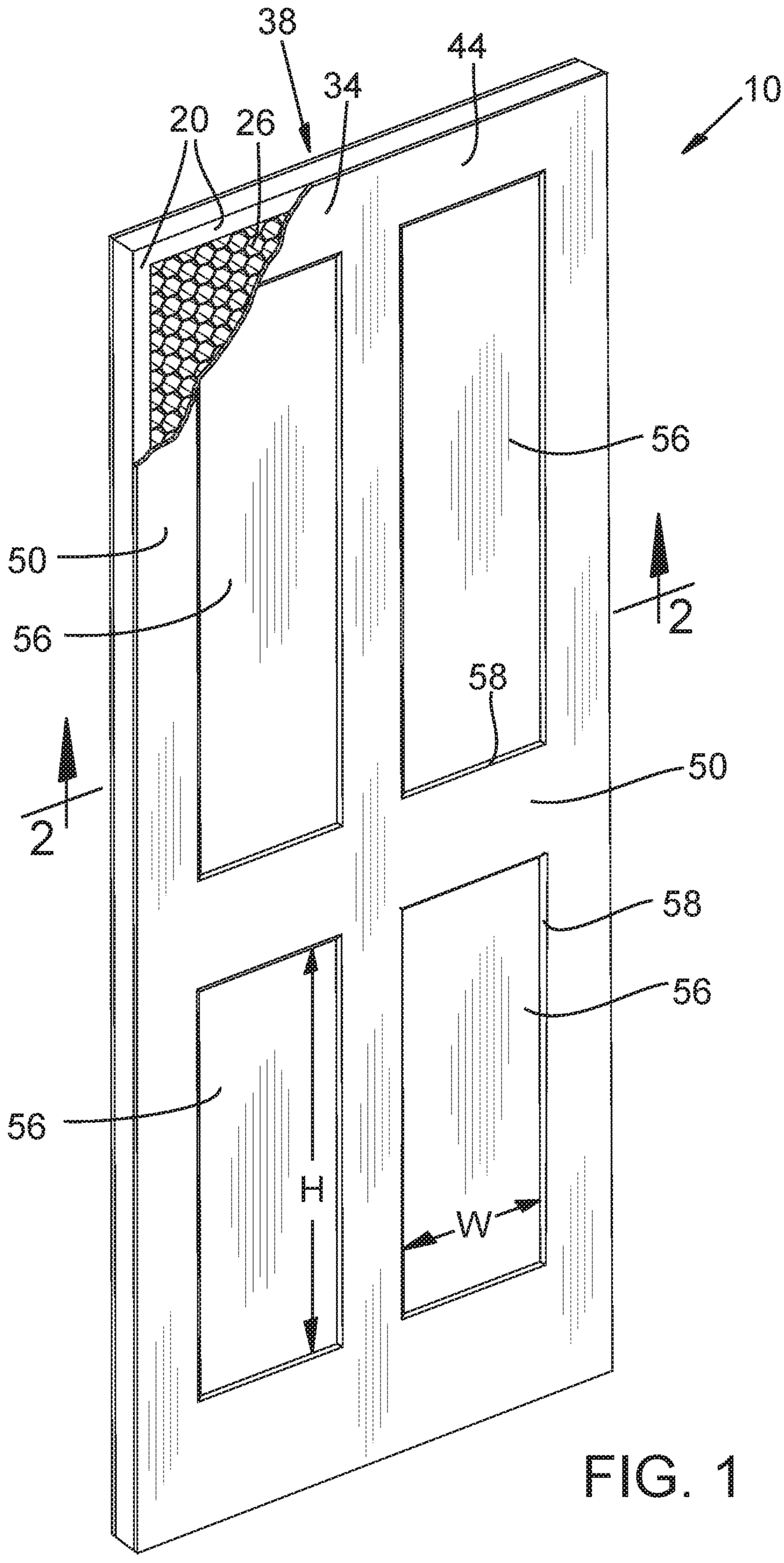


FIG. 1

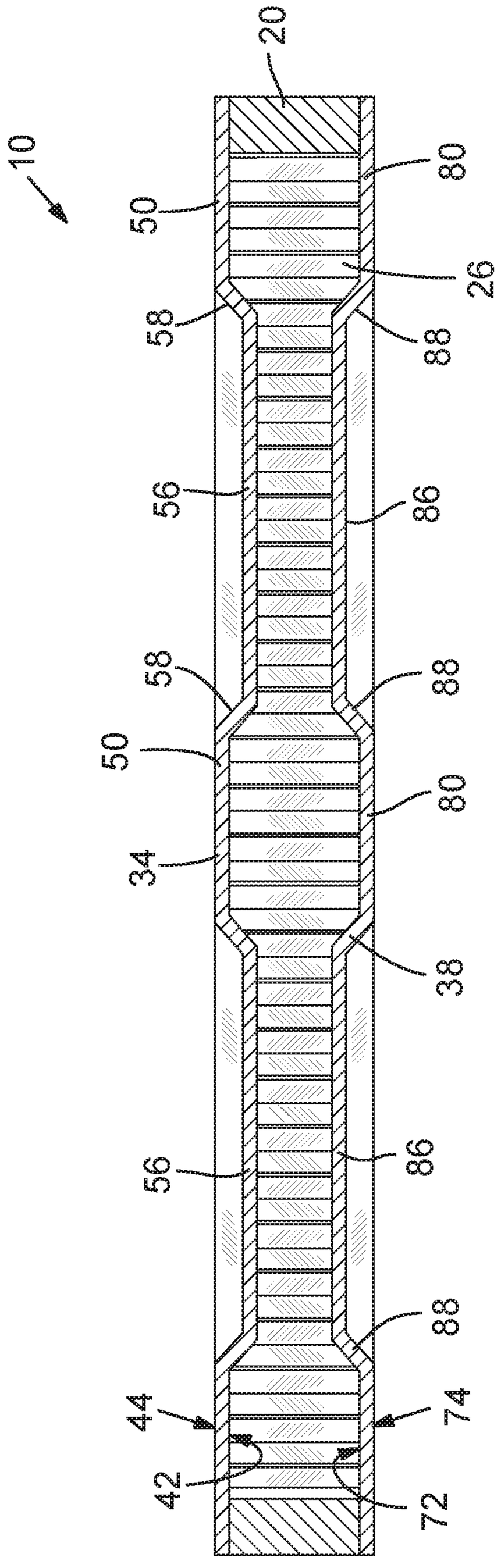
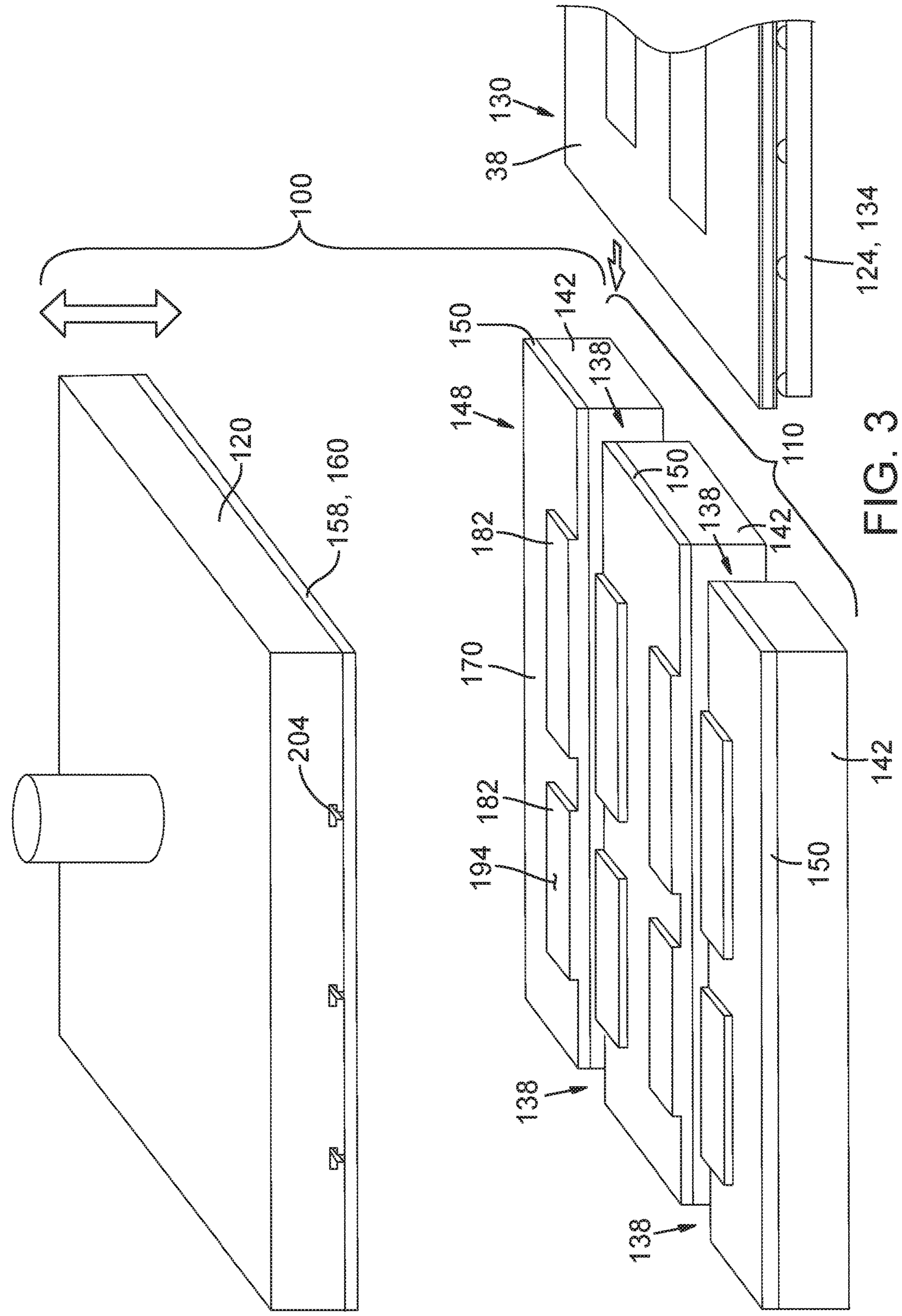


FIG. 2


100
120
158, 160
204
130
38
124, 134
142
150
148
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110
182
170
194
182
150
138
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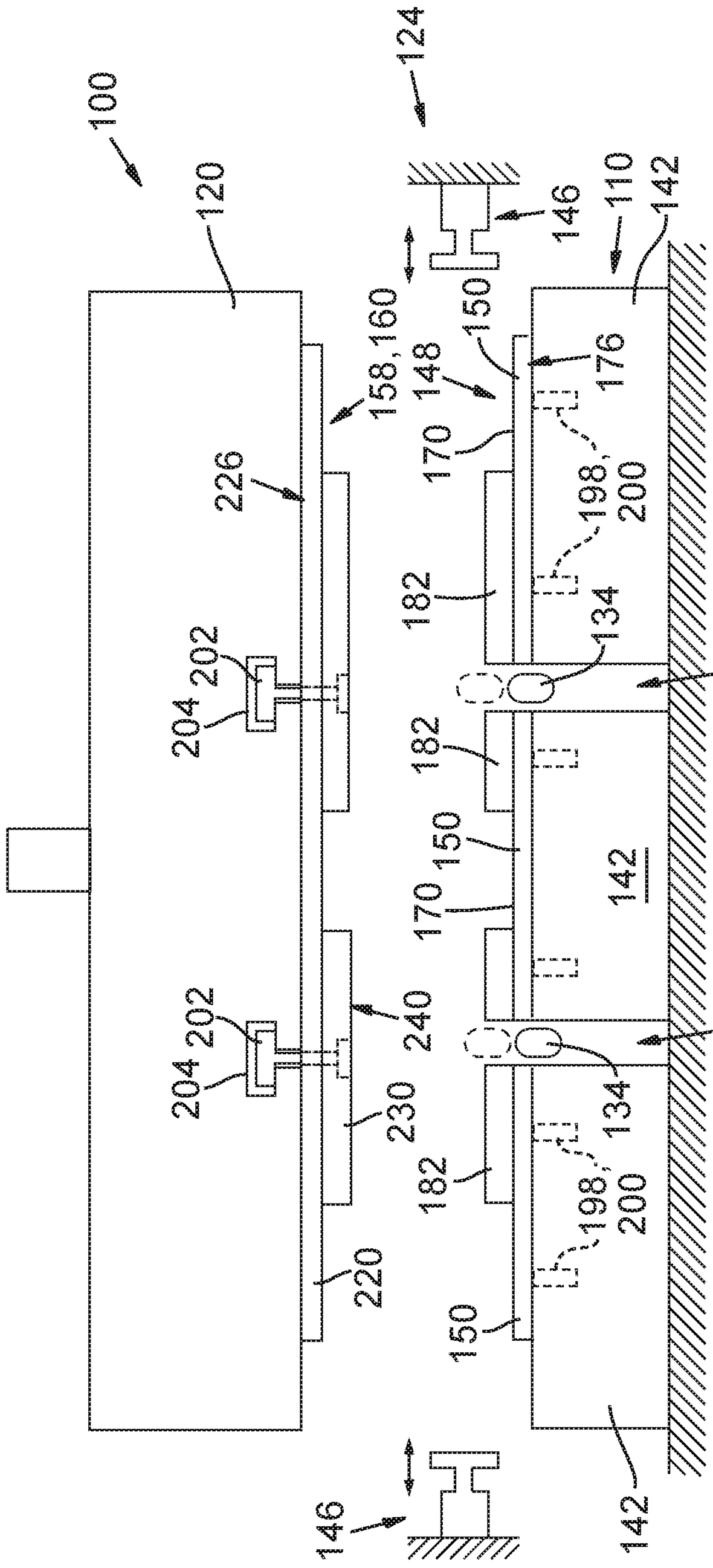
138
138

FIG. 3


100
120
124
146
110
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160
150
158,162
148
176
170
198,
200
226
182
134
138
204
202
240
230
220

FIG. 4

METHOD FOR ASSEMBLY OF RECESSED PANEL DOORS

RELATED APPLICATION

This application claims the benefit under 35 U.S.C. § 119(e) from U.S. Provisional Patent Application No. 62/217,710, filed Sep. 11, 2015, which is incorporated herein by reference.

TECHNICAL FIELD

The field of the present disclosure relates to systems and methods for assembling doors.

BACKGROUND

A known method of assembling doors involves applying adhesive to an inside surface of two door skins; laying up a door assembly by stacking an internal frame and lightweight core material between the door skins; pre-pressing the door assembly to bring the adhesive into contact with the frame; and then feeding the pre-pressed doors into a separate heated press for curing the adhesive. Some such door skins include inwardly-contoured channels that simulate the sticking regions of a traditional solid wood door.

SUMMARY

In one embodiment, a system for making a door assembly from a stack of door components including first and second door skins, an internal frame, and a core, comprises a lower die section removably seated on a lower platen of a press and an upper die section removably attached to an upper platen of a press. At least one of the lower and upper die sections includes a base and one or more raised sections that stand off from the base to contact and support one or more recessed panel portions of the door skins during the pressing operation. The raised sections have a height above the base approximately equal to or greater than the depth of the recessed panel portions.

The upper and lower die sections are preferably made of a plastic material that is relatively soft and non-marring to reduce the possibility of damage to the door skins, and which is light weight to facilitate changing out the die sections for different sizes and styles of doors.

A method of making a door assembly includes seating a lower die section against a lower platen of a press, attaching an upper die section to an upper platen of the press, and positioning a door assembly within the press so that a raised section of the lower die section contacts the recessed panel portions of a first door skin of the door assembly. Thereafter, the method involves closing the press so that a raised section of the upper die section contacts the recessed panel portion of a second door skin of the door assembly, and pressing the door assembly between the upper and lower platens of the press with the recessed panel portions of the first and second door skins supported by the raised sections of the lower and upper die sections, respectively, so that the recessed panel portions press against the core of the door assembly to thereby compress and deform the core therebetween during pressing.

Additional aspects and advantages will be apparent from the following detailed description of preferred embodiments, which proceeds with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an isometric front view of a recessed-panel door, partially broken away to reveal an internal frame and expanded paper honeycomb core construction.

FIG. **2** is a schematic cross section view of the door of FIG. **1** taken along line **2-2** of FIG. **1** (not to scale).

FIG. **3** is a pictorial schematic illustration of a press system for pressing together components of a recessed panel door, illustrated partially.

FIG. **4** is a schematic elevation view of the press system of FIG. **3**.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

FIGS. **1** and **2** show an exemplary door **10**, made by the method and system disclosed herein. With reference to FIGS. **1-2**, door **10** includes an internal frame **20** that extends around a perimeter of door **10** to define a cavity filled by a core **26**. A first (or front) door skin **34** overlays a front surface of frame **20** and core **26**. A second (or rear) door skin **38** (FIG. **2**) overlays a rear surface of frame **20** and core **26** opposite the front surface. First door skin **34** includes an inner surface **42** which faces core **26** and frame **20** and an outer surface **44** which forms the front surface of door **10**. Inner surface **42** is attached to the front surface of frame **20** by an adhesive. First door skin **34** preferably has a first planar portion **50** lying in a first plane. First planar portion **50** generally surrounds one or more recessed panel portions **56** (or panel regions) formed in first door skin **34**, and may present the appearance of conventional stiles and rails. Recessed panel portions **56** appear as shallow indented regions in the outer surface **44** of first door skin **34**, recessed relative to first planar portion **50**. Recessed panel portions **56** may have a rectangular shape and planar surface as shown, or may have other regular or irregular shapes and contours contributing to the overall aesthetic design of door **10**. Each recessed panel portion **56** may have a depth in the range of about 3-15 mm inwardly from first planar portion **50**, for example, and may have width W in the range of about 50 mm to 1 m (or more typically in the range of about 100 mm to 800 mm) and a height H in the range of about 100 mm to 2.5 m (or more typically in the range of about 200 mm to 2 m). Transition regions **58**, known in the art as "sticking" or simulated sticking, connect first planar portion **50** to recessed panel portions **56**. First planar portion **50**, panel portions **56**, and transition regions **58** are preferably formed in a unitary sheet of material, such as molded high density fiberboard, for example, that has a substantially uniform thickness throughout (but may be somewhat thinner at transition regions **58**). One suitable door skin is made of a fiber composite material having a thickness in the range of about 1.1 mm to 6 mm, or 2 mm to 4 mm, or 2.5 mm to 3.5 mm. When first door skin **34** includes multiple recessed panel portions **56**, they are typically substantially co-planar in a second plane that is parallel to and spaced inwardly from the first plane of first planar portion **50**. The recessed panel portions **56** characterize door **10** as a recessed-panel door.

Similarly, second door skin **38** includes an inner surface **72** which faces core **26** and frame **20** and an outer surface **74** forming a rear surface of door **10**. Second door skin **38** is attached to the rear surface of frame **20** by an adhesive. In second door skin **38**, simulated stiles and rails comprise a second planar portion **80** lying in a third plane spaced apart from the first and second planes of first door skin **34**. Second planar portion **80** surrounds one or more recessed panel

portions (or panel regions) **86** that are recessed relative to second planar portion **80**. Transition regions **88** (sticking), connect second planar portion **80** to recessed panel portions **86**. When second door skin **38** includes multiple panel portions **86**, they are typically substantially co-planar in a fourth plane parallel to and spaced inwardly from the third plane of second planar portion **80**. Recessed panel portions **86** may have similar dimensions in width, height, and depth as recessed panel portions **56** of first door skin **34**, or different dimensions and depth. In an alternative embodiment (not shown), one of the first and second door skins **34**, **38** may have a different ornamental design, different contours, different sticking, or panel regions that are not recessed, or may be entirely flat (flush) and lacking simulated sticking entirely.

In a preferred embodiment, core **26** comprises an expanded paper honeycomb material, which has a relatively high strength to weight ratio, but which is crushable by the press systems and methods described below. For example, the expanded paper honeycomb material of core **26** may have a compressive strength in the range of about 1.0 kg force per square cm (kgf/cm^2) to about 15 kgf/cm^2 (100 kPa to 1470 kPa) or more typically in the range of about 4 kgf/cm^2 to about 8 kgf/cm^2 (390 kPa to 785 kPa). Other structural materials that can be crushed or compressed under sufficient pressure may also be used for core **26**, for example, expanded plastic film honeycomb material, corrugated cardboard, low density foam board, and others. Door skins **34**, **38** are pre-formed in a door skin press process, including pre-forming recessed panel portions **56**, **86** and transition regions **58**, **88**. Adhesive (not illustrated) is applied between first door skin **34** and frame **20** and between second door skin **38** and frame **20** to bond the door skins **34**, **38** to frame **20**. Frame **20** may be coated with adhesive before being stacked together with door skins **34**, **38**. Alternatively, door skins **34**, **38** may be coated in the region of frame **20** or over their entire surface so they also adhere to core **26**.

Methods of assembling door **10** will now be described with reference to an exemplary pressing system illustrated in FIGS. **3-4**. Turning to FIG. **3**, the system includes a press **100** (illustrated schematically) for pressing together components of a door **10**, so as to ensure positive contact between adhesive-coated surfaces of the internal frame **20** with door skins **34**, **38**. The pressing operation also compresses the core **26** between the recessed panel regions **56**, **86** of door skins **34**, **38**, as will be further described below. Subsequent to pressing in press **100**, the pressed door assembly may be transferred to a separate heated press for curing the adhesive, then trimmed, finished, and packaged for shipment or sale.

Press **100** includes a lower platen **110** and an upper platen **120**. In the embodiment illustrated, a workpiece transport and positioning subsystem **124**, described below with reference to FIG. **4**, feeds a partially pre-assembled and stacked collection of door components **130**, laid flat, into press **100**. Door components **130** include first and second door skins **34**, **38** stacked on either side of frame **20** and core **26**. The workpiece transport and positioning subsystem **124** aligns the door components **130** relative to the press **100**, and ejects the pressed door components **130** from the press **100** after pressing. For example, lower platen **110** may be segmented to accommodate tracks of a roller conveyor **134** (FIG. **4**) in channels or gaps **138** between segments **142** of lower platen **110**. In a preferred embodiment, the roller conveyor **134** and an alignment mechanism **146** of the workpiece transport and positioning subsystem **124** are moveable to align door components **130** with each other and relative to press **100** and then to retract, so as not to interfere with the pressing operation.

Press **100** includes a lower die **148** comprising one or more lower die sections (or lower jigs) **150** seated on lower platen **110**, and an upper die **158** comprising one or more upper die sections (or upper jigs) **160** attached to upper platen **120**. In the embodiment illustrated, the lower die **148** includes three lower die sections **150**, each of which is seated on one of the three segments **142** of lower platen **110**, and the upper die **158** includes one upper die section **160** attached to upper platen **120**. In other embodiments, a greater or lesser number of platen sections and/or die sections may be utilized. The lower die sections **150** are configured as a set, to collectively fit one or more particular door designs. Each of lower die sections **150** includes a base **170**, having a bottom surface (seating surface) **176** which rests on lower platen **110**, and at least one raised section **182** opposite bottom surface **176** and protruding from base **170**. Consistent with the configuration and proportions of recessed panel portions **56** relative to first planar portion **50**, each raised section **182** is generally narrower and shorter than base **170**, and therefore has a smaller surface area than base **170**. In the embodiment illustrated, each of the lower die sections **150** has multiple raised sections **182**, which are sized and arranged to support the multiple recessed panel portions **56** of first door skin **34** during pressing (which may sometimes span the gaps **138** during a pressing operation). Raised sections **182** have a height above base **170** corresponding to the depth of recessed panel portions **56** of first door skin **34** inwardly of first planar portion **50**. Each raised section **182** has a panel-supporting contact surface **194** opposite bottom surface **176** and facing away from lower platen **110**. In yet another embodiment, base **170** is omitted, such that each lower die section **150** comprises only a single raised section **182** directly attached to the lower platen **110** so that the exposed platen surrounds each such raised section **182**. Alternatively, base **170** may have a width and length that entirely underlie raised section **182**.

With reference to FIG. **4**, in the embodiment illustrated, upper die section **160** of upper die **158** is secured to upper platen **120** by mounting bolts and T-nuts **202** captured within T-slots **204** in upper platen **120**, or by any other convenient means of securement. Similarly to lower die sections **150**, upper die section **160** includes a base **220** having a seating surface (top surface) **226** that is held adjacent upper platen **120**, and at least one raised section **230** opposite seating surface **226** and protruding from base **220**. Consistent with the configuration and proportions of recessed panel portions **86** relative to second planar portion **80**, each raised section **230** is generally narrower and shorter than base **220**, and therefore has a smaller surface area than base **220**. In the embodiment illustrated, each of the upper die sections **160** has multiple raised sections **230**, which are sized and arranged to support the multiple recessed panel portions **86** of second door skin **38** during pressing. Raised sections **230** have a height beyond base **220** corresponding to the depth of recessed panel portions **86** of second door skin **38** inwardly of second planar portion **80**. Each raised section **230** has a panel-supporting contact surface **240** opposite seating surface **226** and facing away from upper platen **120**.

Continuing with reference to FIG. **4**, lower die sections **150** are positioned on lower platen **110** adjacent gaps **138**. Each of the lower die sections **150** includes one or more pegs **198** protruding from bottom surface **176** and arranged to engage with holes **200** or depressions in lower platen **110**, for aligning each of lower die sections **150** on lower platen

110. Preferably, each of lower die sections **150** has two pegs **198** slidably fitted in two holes **200** when lower die sections **150** are seated against lower platen **110** to inhibit rotation or sliding of each lower die section **150** along the surface of lower platen **110**. Orientation of lower die sections **150** on lower platen **110** using only pegs **198** makes it possible to remove and change out lower die sections **150** without the use of wrenches or other tools. Alternative means for positioning lower die sections **150** on lower platen **110** may also be provided according to a configuration of slots and protrusions or according to other mating or nesting configurations.

Lower and upper die sections **150**, **160**, and particularly the portions thereof that come into contact with door skins **34**, **38** during pressing, such as contact surfaces **194**, **240**, are preferably made of a relatively soft, low-friction material, such as white polytetrafluoroethylene (PTFE) or another plastic material or a resilient or elastomeric material such as hard non-marking rubber. The working surfaces of die sections **150**, **160**, or at least contact surfaces **194**, **240**, are preferably non-marring by being made of or coated with relatively soft, low friction materials that tend not to scratch or damage door skins **34**, **38** during pressing. For example, die sections **150**, **160** may be made of a plastic material having a hardness in the range of about 80 to 110 Shore A or more preferably in the range of about 90 to 105 Shore A; and having a coefficient of static friction against polished steel of less than about 0.4, or less than 0.15, or preferably less than 0.1, or even less than 0.08, measured in accordance with ASTM D1894. Such materials are also desirably light weight, which may facilitate installation and change-over of die sections **150**, **160** in press **100**. Thus, the system may further include additional sets of one or more replacement die sections removably attachable to platens **110**, **120** in place of one or more of lower and upper die sections **150**, **160**, for pressing different sizes or styles of doors.

Lower and upper die sections **150**, **160** are designed and arranged so that when the stack of door components **130** is positioned within press **100** for pressing, each one of the raised sections **182**, **230** fits within one of recessed panel portions **56**, **86** of the respective door skins **34**, **38**. One purpose of raised sections **182** is to reinforce and support the recessed panel portions **56**, **86** during pressing by press **100**. Reinforcement provided by raised sections **182**, **230** ensures door skins **34**, **38** do not fracture or bow outwardly from frame **20** due to outward pressure exerted by core **26** during the pressing operation. Such reinforcement and the attendant crushing of core **26** also ensures that positive adhesive contact is established and thereafter maintained between door skins **34**, **38** and frame **20**. It is not necessary that contact surfaces **194**, **240** span the full length or width of recessed panel portions **56**, **86**. Sufficient reinforcement can be achieved with discontinuous contact surfaces or segmented raised sections having a smaller width, length, and area than the recessed panel portions **56**, **86**.

The bases **170**, **220** of each of the respective lower and upper die sections **150**, **160** lie adjacent the stiles and rails regions of door skins **34**, **38** (i.e. first and second planar portions **50**, **80**) during pressing. It is not necessary that the bases **170**, **220** span any dimension entirely of planar portions **50**, **80**, but preferably bases **170**, **220** extend beyond the edges of the planar portions **50**, **80**. In one embodiment, the heights of the raised sections **182**, **230** are approximately equal to or slightly greater than the depths of the respective recessed panel portions **56**, **86**. In embodiments wherein raised sections **182**, **230** have a height above their respective bases **170**, **220** that is greater than the depth of recessed panel portions **56**, **86**, the bases **170**, **220** may not come into contact with first and second planar portions **50**, **80**. Instead, pressure applied by raised sections **182**, **230** against panel portions **56**, **86** may both crush the core **26** and ensure positive adhesive contact between door skins **34**, **38**, frame **20**, and the adhesive layer applied therebetween. Alternatively, during pressing, the height of raised sections **182**, **230** being slightly greater than the depth of recessed panel portions **56**, **86** may cause the door skins **34**, **38** to bow slightly inward during the pressing process until bases **170**, **220** come to press against planar portions **50**, **80** and establish adhesive contact between door skins **34**, **38** and frame **20**. Inherent resiliency of the door skins **34**, **38** and core **26** may return the door skins **34**, **38** to their desired flatness after pressing.

During operation, roller conveyor **134** transports the door components **130** into press **100** (wherein roller conveyor **134** is in the raised position indicated by phantom lines in FIG. **4**). Roller conveyor **134** pushes door components **130** into contact with positioning guides or stops (not illustrated) within the press to align the door components **130** longitudinally within press **100** and relative to each other. Concurrently, one or more alignment mechanisms **146** may momentarily push against one or more side edges of the door components **130** to establish their lateral alignment within the press **100**. The alignment mechanisms **146** and positioning guides or stops (not shown) are then retracted before the press platens are closed. In another embodiment, the insertion of door components **130** into press **100** is accomplished manually or by some other means than conveyor **134**. In such an embodiment, lower platen **110** may not include channels or gaps **138**, in which case a single lower die section may replace the plurality of lower die sections **150**. Returning to the embodiment illustrated, roller conveyor **134** retracts beneath the upper surface of lower platen **110** (as shown by solid lines in FIG. **4**), or at least beneath the upper surface of base **170**, placing the stack of door components **130** onto lower die sections **150**.

During the pressing operation, first door skin **34** moves toward frame **20** a distance approximately equal to the depth of recessed panel portions **56**. This motion causes the inner surface **42** of first door skin **34** to be pressed into adhesive contact against the adhesive coating on frame **20**. This motion also causes the recessed panel portions **56** of first door skin **34** to crush (or deform or compress) the portions of core **26** that lie beneath recessed panel portions **56**.

After pressing door components **130** to form an assembled door **10**, the press **100** opens by at least one of lower platen **110** and upper platen **120** moving away from the other. The roller conveyor **134** of workpiece transport and positioning subsystem **124**, lifts the pressed assembled door **10** off of lower die sections **150** until door **10** clears lower die **148** so that it can be transported out of press **100** by motorized rollers of roller conveyor **134**. After the pressing operation in press **100**, door **10** may be fed to a separate heated press station (not shown) for curing the adhesive bonds between door skins **34**, **38** and frame **20**. Alternatively, the press **100** may be heated, eliminating the need for a separate heated press.

It will be obvious to those having skill in the art that many changes may be made to the details of the above-described embodiments without departing from the underlying principles of the invention. The scope of the present invention should, therefore, be determined only by the following claims.

The invention claimed is:

1. A method for making a door assembly of the kind having an internal frame, a core, and first and second door skins attached to the frame on either side of the core, wherein each of the door skins has a planar portion bordering at least one recessed panel portion, said method comprising:

seating a lower die section against a lower platen of a press so that a base of the lower die section is supported on the lower platen and a raised section of the lower die section stands off from the base thereof;

attaching an upper die section to an upper platen of the press so that a base of the upper die section is supported by the upper platen and a raised section of the upper die section stands off from the base thereof;

positioning a stack of door components within the press, including:

positioning a first door skin in the press with a recessed panel portion of the first door skin facing downward and contacting the raised section of the lower die section,

positioning a frame in the press over the first door skin, the frame defining a cavity,

positioning a compressible core in the press overlying the first door skin and within the cavity defined by the frame, and

positioning a second door skin in the press overlying the compressible core and the frame, with a recessed panel portion of the second door skin facing upward;

closing the press so that the raised section of the upper die section contacts the recessed panel portion of the second door skin; and

pressing the stack of door components between the lower and upper platens of the press with the recessed panel portions of the first and second door skins supported by the raised sections of the lower and upper die sections, respectively, so that the recessed panel portions compress and deform a portion of the compressible core of the door assembly underlying the recessed panel portions, to thereby form a door assembly.

2. The method of claim **1**, further comprising removing the upper and lower die sections from the press and installing a set of replacement die sections for pressing a second style of door, including installing a lower replacement die section on the lower platen and attaching an upper replacement die section to the upper platen.

3. The method of claim **1**, wherein:

the stack of door components includes an adhesive between the first door skin and the frame, and between the second door skin and the frame; and

wherein the pressing of the stack of door components results in adhesive contact between the first door skin and the frame, and between the second door skin and the frame.

4. The method of claim **3**, further comprising, after forming the door assembly, transferring the door assembly to a separate heated press and pressing the door assembly in the separate heated press to cure the adhesive.

5. The method of claim **1**, wherein the lower and upper die sections are made of a plastic material.

6. The method of claim **1**, wherein the lower and upper die sections include non-marring contact surfaces which contact the recessed panel portions of the respective first and second door skins when the press is closed.

7. The method of claim **1**, wherein the lower and upper die sections are made of a resilient material.

8. The method of claim **1**, wherein the lower and upper die sections are made of a material having a coefficient of static friction against polished steel of less than 0.15.

9. The method of claim **1**, wherein the lower and upper die sections are made of PTFE.

10. The method of claim **1**, wherein the raised sections of the lower and upper die sections have a smaller surface area than the recessed panel portions of the respective first and second door skins.

11. The method of claim **1**, wherein the lower die section includes at least one peg depending downwardly from the base of the lower die section and inserted into a hole in the lower platen to align the lower die section with the lower platen.

12. The method of claim **1**, wherein one or both of the lower and upper die sections has multiple raised sections sized and arranged to support multiple recessed panel portions during pressing.

13. The method of claim **1**, wherein the stack of door components are positioned in the press via a workpiece transport and positioning subsystem that transports a pre-stacked collection of the door components into the press.

14. The method of claim **1**, wherein the height of the raised sections above the base of the respective lower and upper die sections is such that, during the pressing of the stack of door components, the base of the of the lower die section contacts the planar portion of the first door skin and the base of the upper die section contacts the planar portion of the second door skin.

15. The method of claim **1**, wherein the pressing of the stack of door components between the lower and upper platens of the press causes the recessed panel portions to crush a portion of the compressible core of the door assembly underlying the recessed panel portions.

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